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ABSTRACT

Designed to focus on teaching for higher-level cognitive learning, this study measured student perceptions of psychosocial aspects of their classroom learning and involved a team of six researchers. The study consisted of an intensive 10-week investigation of two above-average science teachers in a suburban high school in Perth, Western Australia. Responses to classroom environment scales assessing personalization, participation, order and organization, and task orientation were used to: (1) contrast the classroom environments of two different teachers; (2) examine changes in environment that occurred with a change in the topic being taught; (3) investigate differences between student, teacher and researcher perceptions; and (4) examine differences between student actual and preferred perceptions. Two grade 10 science classes, one with a male teacher and the other with a female teacher were observed during the teaching of two separate topics, vertebrates and nuclear energy. The study examined the influence of the teachers' knowledge limitations on the implemented curriculum, the overemphasis on content knowledge, and the nurturing of student misconceptions. Ethnographic techniques were employed in the study. (ML)

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# TEACHING FOR HIGHER COGNITIVE LEVEL LEARNING IN HIGH SCHOOL SCIENCE

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This paper reports one aspect of a comprehensive study which involved a team of six researchers (including Ken Tobin, Jane Butler Kahle and Maggie Gremli) whose papers also are part of this symposium. This study involved an intensive 10-week investigation of two above-average science teachers in a suburban high school in Perth, Western Australia. The data base for the study consisted of observations of over 200 science lessons, tape-recordings of some lessons, interviews with students and teachers and student responses to written questionnaires. This comparatively large research team provided diverse perspectives which lead to complementary views of classroom life.

Overall, the focus of the study was on teaching for higher-level cognitive learning. The different methods and elements of the study blend together to provide a composite picture of various aspects of teaching and learning in science classrooms. One of the strengths and distinctive features of the study is the range of methods used for collecting and interpreting data. In particular, the investigation incorporated an interpretive research methodology (Erickson, 1986) which emphasized use of both qualitative and quantitative data, responsiveness to emergent problems and issues during the study and regular interaction among members of the research team.

Two Grade 10 science classes, one with a male teacher (Teacher A) and the other with a female teacher (Teacher B) were observed during the teaching of two separate topics, namely, Vertebrates and Nuclear Energy. While one topic was within the teachers' field of expertise, the other topic was "out of field". The study examined links between the extent of teachers' knowledge of a topic and the activities followed by the teachers as the curriculum for that topic was implemented. The research provides insights into what teachers and students were doing in the classroom in terms of managing student behaviour, managing the development of content and facilitating higher-level cognitive learning. For example, the study highlights the influence of teachers' knowledge limitations on the implemented curriculum, the overemphasis on content coverage at the expense of meaningful learning, the typically low cognitive demand of the academic work and the nurturing of student misconceptions.

The specific part of the study described in this paper involved the collection of data based on questionnaires assessing student perceptions of psychosocial aspects of their classroom learning environment. The methodological contribution of this part of the research is that it complemented the qualitative information collected using ethnographic techniques and that it focussed on classroom characteristics as seen through the eyes of the students.

## BACKGROUND: ASSESSMENT OF CLASSROOM ENVIRONMENT

The field of classroom environment and a range of measuring instruments are reviewed comprehensively in Chavez (1984), Fraser (1981, 1986a, 1986b), Moos (1979) and Walberg (1979). In this study of higher-level cognitive learning, use was made of selected scales from the Individualized Classroom Environment Questionnaire (ICEQ) (Fraser, 1987; Rentoul & Fraser, 1979) and the Classroom Environment

Scale (CES) (Moos & Trickett, 1986; Trickett & Moos, 1973). In fact, an important feature of the design of the present study was that these classroom environment dimensions were selected after a certain amount of field work had been done and, consequently, only dimensions considered to be salient were selected for inclusion in the research.

The ICEQ was developed to assess those dimensions which distinguish individualized classrooms from conventional ones. As well as having an actual form, the ICEQ also has a preferred form to assess the environment ideally liked or preferred. ICEQ scales each contain 10 items with the five response alternatives of Almost Never, Seldom, Sometimes, Often and Very Often. Research involving the ICEQ has established links between student outcomes and classroom environment (Fraser & Fisher, 1982), has shown that students achieve better in their preferred classroom environment (Fraser & Fisher, 1983a) and has suggested the usefulness of classroom environment perceptions in facilitating environmental change (Fraser, Seddon & Eagleson, 1982).

The initial development of the CES grew out of Moos' program of research in a variety of human environments including hospital wards, therapy groups, military companies, university residences and work settings (Moos, 1974). The published version of the CES consists of nine scales, each assessed by 10 items of True-False response format, and there is a preferred form as well as an actual form. Some of the research involving the CES has involved investigation of the effects of classroom environment on student outcomes (Fraser & Fisher, 1982), whether students achieve better in their preferred classroom environment (Fraser & Fisher, 1983b), differences between various types of school (Trickett, 1978) and differences between student and teacher perceptions of actual and preferred classroom environment (Fisher & Fraser, 1983).

For the purposes of the present study, the four scales selected as salient were the Personalization and Participation scales from the Individualized Classroom Environment Questionnaire (ICEQ) and the Order and Organization and Task Orientation scales from the Classroom Environment Scale (CES). Students responded to both the actual and preferred forms of each scale and also answered the questionnaires on two occasions, once during the teaching of Vertebrates and again during the teaching of Nuclear Energy. Also, for the two scales from the CES, the original two-point (True, False) response format was changed to the same five-point response format as the ICEQ (Almost Never, Seldom, Sometimes, Often, Very Often). Table 1 clarifies the meaning of each of these four scales by providing a scale description and sample item for each scale.

Although item wording is almost identical in actual and preferred forms, words such as "would" are included in the preferred form to remind respondents that they are rating preferred environment. For example, the statement "This is a well-organized class" in the actual form would be changed in the preferred form to "This would be a well-organized class."

TABLE 1. Scale Description, Sample Item and Alpha Reliability Coefficient for Four Classroom Environment Scales

| Scale | Scale Description | Sample Item | Alpha Reliability | |
|---|---|---|---|---|
| | | | Actual | Pref. |
| Personalization | Emphasis on opportunities for individual students to interact with the teacher and on concern for the personal welfare and social growth of the individual | The teacher takes a personal interest in each student.(+) | 0.90 | 0.86 |
| Participation | Extent to which students are encouraged to participate rather than be passive listeners | The teacher lectures without students asking or answering questions.(-) | 0.80 | 0.75 |
| Order and Organization | Emphasis on students behaving in an orderly, quiet and polite manner and on the overall organization of classroom activities | This is a well-organized class.(+) | 0.90 | 0.86 |
| Task Orientation | Extent to which it is important to complete activities planned and to stay on the subject matter | This class is more a social hour than a place to learn something.(-) | 0.72 | 0.65 |

Items designated (+) are scored 1, 2, 3, 4 and 5, respectively, for the responses Almost Never, Seldom, Sometimes, Often and Very Often. Items designated (-) are scored in the reverse manner. Omitted or invalid responses are scored 3.

Reliability data are based on 150 classes for Personalization and Participation and on 116 classes for Order and Organization and Task Orientation.

Table 1 also provides data on the internal consistency reliability (alpha coefficient) for each scale. Data are based on use of the class mean as the unit of analysis for 150 junior high school classes for the ICEQ and for 116 junior high school classes for the CES (see Fraser, 1986a). Reliability estimates are shown in Table 1 separately for the actual and preferred forms. However, reliability data for the two CES scales were obtained using its original two-point item response format rather than the five-point response format used in the present research.

## USES OF CLASSROOM ENVIRONMENT DATA

There is considerable potential to link the quantitative data obtained through administration of classroom environment scales with the variety of other data collected as part of the overall study. In this section, some of these applications are described and their usefulness in complementing other data-gathering methods is assessed.

### Contrasts Between the Two Teachers

Figure 1 depicts the profiles of mean actual classroom environment scores obtained by averaging the individual scale scores of the 31 students in Teacher A's class and the 31 students in Teacher B's class. These profiles have been constructed separately for the first topic of Vertebrates (the "in field" topic) and for the second topic of Nuclear Energy (the "out of field" topic).

An interesting question is whether any of the researchers' observations about the two teachers are consistent with information about student perceptions of their classrooms as captured by the four classroom environment scales. Figure 1 clearly shows that the two greatest student-perceived differences between the teachers for both topics was that, relative to Teacher A's class, Teacher B's class was characterized by considerably more Personalization and less Order and Organization. (Moreover, two-way analyses of variance with class and gender as independent variables revealed that differences were significant at the 0.01 level of confidence for Personalization and Order and Organization for both topics. All other differences were nonsignificant, with the exception that Teacher B's class was seen as having significantly more Participation than Teacher A's class for the second topic of Nuclear Energy.) It is noteworthy that these findings, in fact, are highly consistent with the researchers' classroom observations which also suggested that Teacher B was much more successful than Teacher A in establishing good relationships with students (Personalization), but that Teacher B had difficulties in controlling the behaviour of certain troublesome students (Order and Organization).

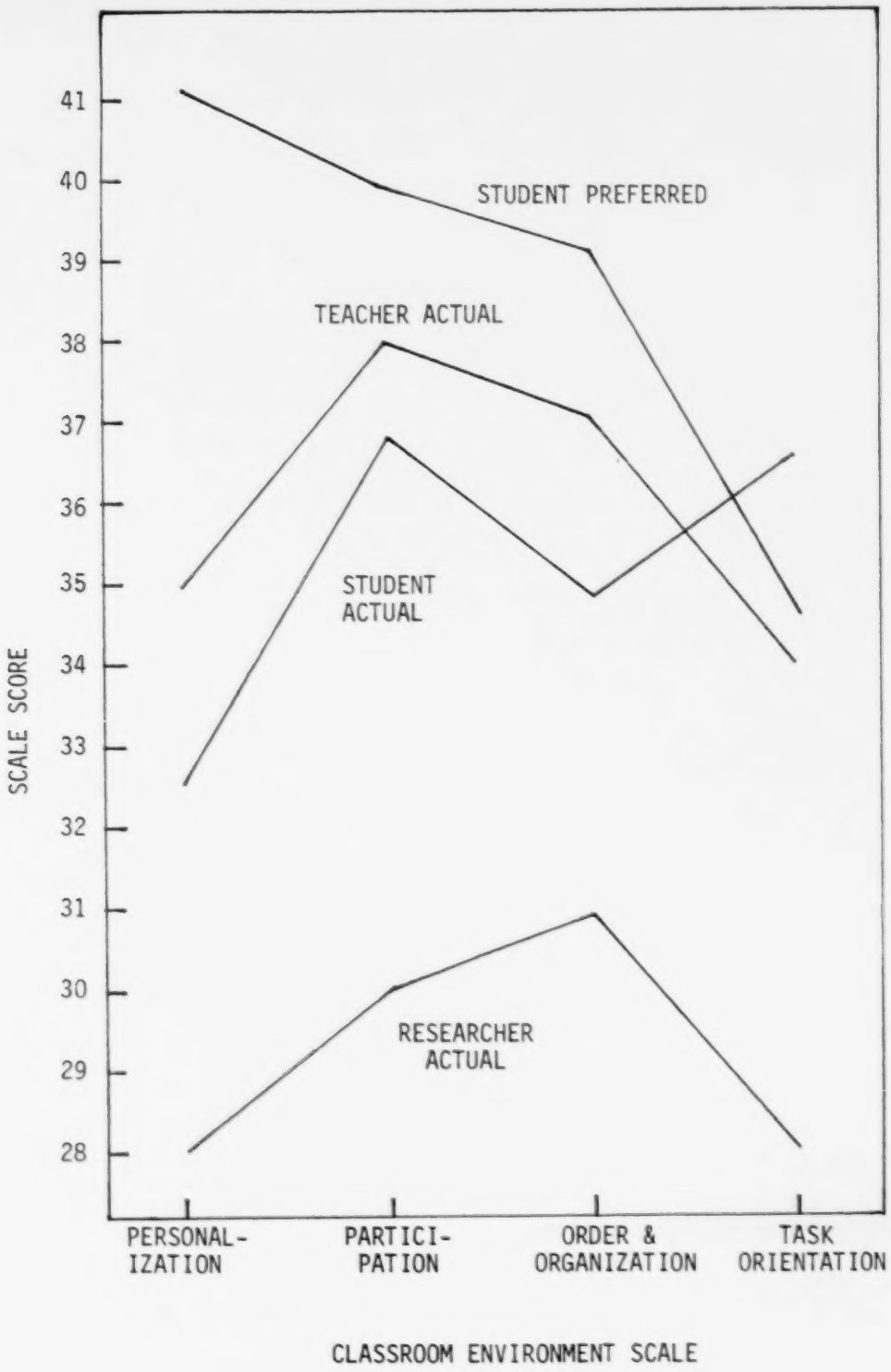


FIGURE 2. Researcher Actual, Student Actual, Teacher Actual and Student Preferred Classroom Environment Profiles for Teacher A for "Vertebrates" Topic

## Contrasts Between the Two Topics

Whereas the large differences between the two teachers on actual Personalization and Order and Organization were clearly evident for both topics, another question to ask is whether students perceived their classrooms differently during the teaching of the two topics. This question was interesting for two reasons. First, because the researchers had fed back information from the first administration of the classroom environment scales to the teachers, there was the possibility that they might have used this information to stimulate and guide improvements in their classroom environments. Second, because the first topic was "in field" and the second topic was "out of field", there was the possibility that classroom climate could be less favourable during the second topic (if it is assumed that teachers' activities are influenced by their content knowledge).

Although the changes in classroom environment occurring between the two topics are not large, the profiles in Figure 1 still reveal some interesting and consistent patterns. First, Teacher A's classroom environment was less favourable for the second topic than the first on all scales except Order and Organization (for which the difference was negligible). This accords with the researchers' observations that Teacher A did not cope well with teaching out of field and that he did not respond positively to the researchers' suggestions about attempting to improve his classroom environment based on information from the first administration of the environment scales. On the other hand, Teacher B managed to improve on all four dimensions between the two testing occasions. Again, this is consistent with the researchers' observations that this teacher coped reasonably well with teaching "out of field" and that she made a genuine attempt to improve her classroom climate in the light of feedback information about students' perceptions during her teaching of the first topic.

## Differences Between Student, Teacher and Researcher Perceptions

Because the two teachers and four of the researchers also responded to the same classroom environment scales, it is possible to compare the perceptions of the same actual classroom environment held by these three different groups. Figure 2 shows, for Teacher A, profiles of mean scores for the 31 students, of mean scores for the four researchers and of the scores obtained by Teacher A. The profiles in Figure 2 show two clear patterns. First, with the exception of the Task Orientation scale, the teacher viewed the classroom environment more positively than did the students in the same classroom; this finding replicates past research in science classrooms in which teachers consistently viewed classroom climates more favourably than students (Fisher & Fraser, 1983). Second, the group of researchers perceived the classroom environment much less favourably on all scales than did either the teacher or the students.

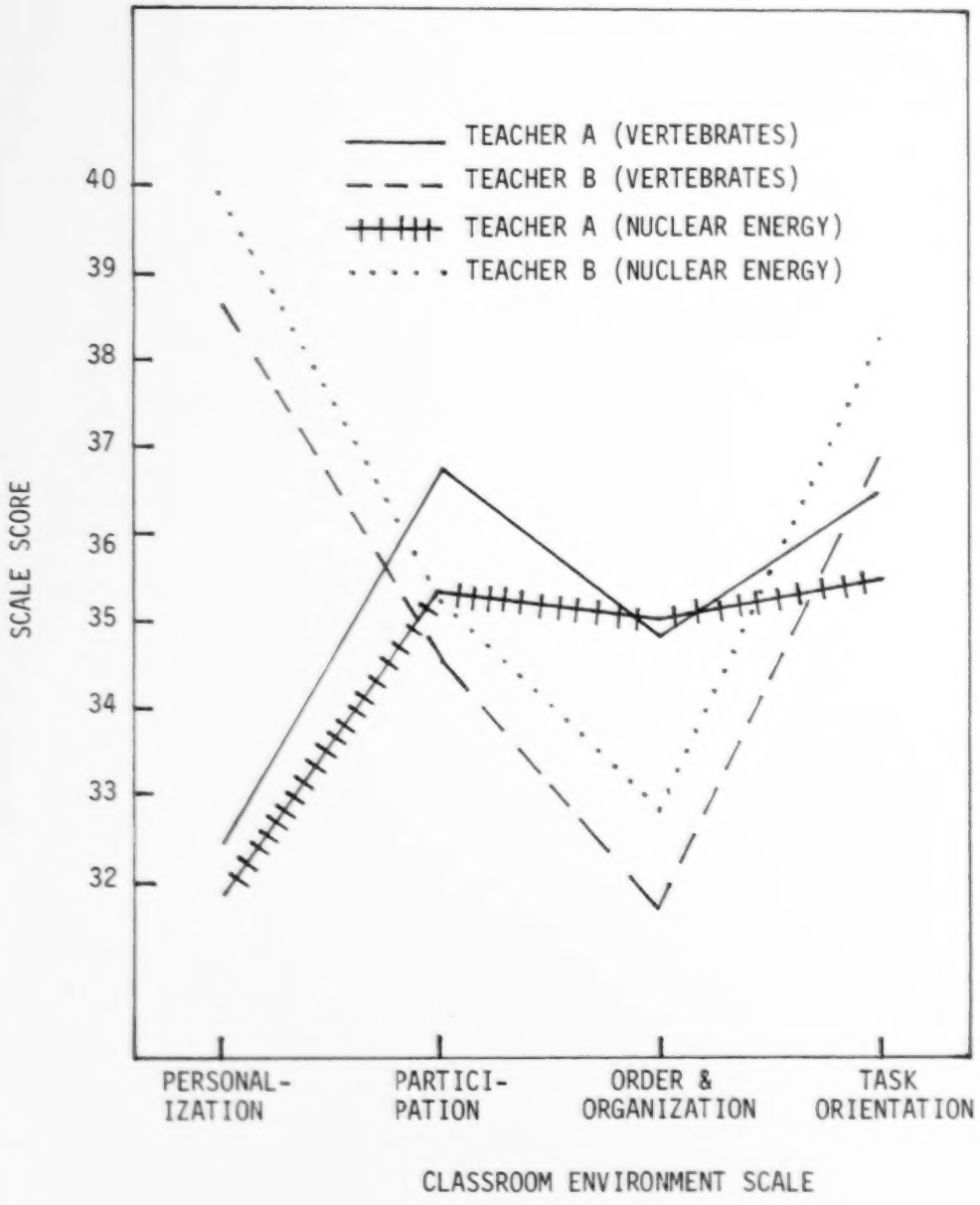


FIGURE 1 Classroom Environment Profiles for Two Teachers for Two Topics

### Differences between Student Actual and Preferred Perceptions

Figure 2 also depicts the profile of mean scores for Teacher A's class on the preferred form of the four classroom environment scales. Clearly, students would prefer somewhat more emphasis on all four dimensions of Personalization, Participation, Order and Organization and Task Orientation than the emphasis perceived to be actually present. Again this finding that actual classroom environments fell short of those preferred by students replicates results from past research (Fisher & Fraser, 1983).

### Other Questions

Currently, a variety of other questions is being explored using available classroom environment data. For example, a comparison of the perceptions of boys and girls suggests that boys and girls within the same class could experience somewhat different actual classroom environments and that girls and boys differ in their classroom environment preferences. Similarly, concrete students are being compared with formal students (in the Piagetian sense) in terms of their classroom climate perceptions. Also a number of linkages are being attempted between observational data and classroom environment data for specific students of interest; for example, case studies are being constructed of students with especially large actual-preferred discrepancy scores. Finally, the classroom environment results are being correlated with available interview, achievement and attitude data.

## CONCLUSION

From a methodological perspective, the inclusion of classroom environment questionnaires among a range of data-gathering techniques is noteworthy for several reasons. First, the complementarity of qualitative observational data and quantitative classroom environment data adds to the richness of the data base. Second, the use of classroom environment questionnaires provides an important source of students' views of their classrooms. Third, through a triangulation of classroom climate and other data, greater credibility can be placed on findings because patterns have emerged consistently from data obtained using a range of different data collection methods.

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